

IN THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Cancelled)
2. (Previously Presented) The microscope according to claim 24 characterised in that the probe is metallic and the parameter indicative of the interaction is capacitance of an interface between probe and sample.
3. (Cancelled)
4. (Previously Presented) The microscope according to claim 2 characterised in that a second parameter indicative of the interaction, and the one on which the feedback mechanism (26) operates, is oscillation amplitude.
5. (Previously presented) The microscope according to claim 2 characterised in that the probe detection mechanism (24, 56, 58) comprises a modulation signal generator (48) arranged to apply a modulating voltage across the interface between probe (20, 54) and sample (12) in order to modulate its characteristics and thereby to affect its electrical capacitance, a resonator (42) arranged to set up a resonating electric field in a circuit incorporating the probe (20,

54) and sample (12) and a detector (46) arranged to measure the electric field resonant frequency and thereby to enable variations in the capacitance of the interface to be measured as the modulating voltage is applied.

6. (Previously Presented) The microscope according to claim 24 characterised in that the probe (20) is adapted to interact with a magnetic field and the probe detection mechanism (24, 56, 58) is arranged to measure a parameter indicative of the magnetic interaction between the probe (20, 52) and the sample (12).

7. (Previously Presented) The microscope according to claim 24 characterised in that the probe (20) comprises a cantilever and actuator arranged to drive the cantilever in a "tapping" mode.

8. (Previously presented) The microscope according to claim 7 characterised in that the parameter indicative of the strength of the interaction is bending of the cantilever as it taps the sample (12).

9. (Previously Presented) The microscope according to claim 24 characterised in that the probe (54) is an AFM cantilever and the one of the at least one parameter indicative of the strength of the interaction that is measured by the

probe detection mechanism (24, 56, 58) and used by the feedback mechanism (26) is bending of the probe (54).

10. (Previously presented) The microscope according to claim 9 characterised in that the probe detection mechanism (24, 56, 58) comprises an interaction detection mechanism (56) arranged to measure at least one parameter indicative of the strength of the interaction between the probe (54) and the sample (12) and a deflection detection mechanism (58), the deflection detection mechanism being linked to the feedback mechanism (26) and arranged to measure bending of the probe (54).

11. (Previously presented) The microscope according to claim 9 characterised in that the probe (54) comprises an actuator arranged to drive the cantilever in "tapping" mode.

12. (Previously Presented) The microscope according to claim 24 characterised in that the driving means (22) is arranged to oscillate the probe (20).

13. (Previously presented) The microscope according to claim 12 characterised in that the driving means (22) includes a tuning fork.

14. (Previously Presented) The microscope according to claim 24 characterised in that the means for oscillating (22, 52) either the probe or the sample is arranged to oscillate the sample (12).

15. (Previously presented) The microscope according to claim 14 characterised in that the means for oscillating the sample is a tuning fork (52) and the sample (12) is attached thereto.

16. (Previously Presented) The microscope according to claim 24 characterised in that the feedback mechanism (26) operates with a time constant which is greater than one cycle of probe oscillation and significantly less than total time taken to perform a scan.

17. (Previously presented) The microscope according to claim 12 characterised in that the probe is oriented substantially vertically and the driving means (16, 22) is arranged to provide a relative linear translation of probe (20) and sample (12) in a direction substantially orthogonal to a probe oscillation plane, thereby defining a substantially rectangular scan area, the probe oscillation plane being defined by the orientation of the probe and an oscillation direction which is orthogonal to the orientation of the probe.

18. (Currently amended) The microscope according to claim 12 ~~or 13~~ characterised in that the probe is oriented substantially horizontally and the driving means (16, 22) is arranged to provide a relative linear translation of probe (20) and sample (12) in a direction substantially parallel to a probe oscillation plane, thereby defining a substantially rectangular scan area, the probe oscillation plane being defined by the orientation of the probe and an oscillation direction which is orthogonal to the orientation of the probe.

19. (Currently amended) The microscope according to claim 12 ~~or 13~~ characterised in that the probe is oriented substantially vertically and the driving means (16, 22) is arranged to provide a relative rotation of probe (20) and sample (12) about an axis substantially coincident with that about which the probe (20) is oscillated, thereby covering the scan area by a circular arrangement of scan lines.

20. (Cancelled)

21. (Currently amended) A method of rapidly collecting image data from a scan area of a sample (12) with nanometric features wherein the method comprises the steps of:

- (a) Moving a probe (20, 54) with tip of sub-nanometric dimensions into close proximity with a sample (12) in order to allow an interaction to be established between probe (20, 54) and sample (12);

- (b) Laterally oscillating either the probe (20, 54) across the surface of the sample (12) at or near its resonant frequency or the sample (12) beneath the probe (20, 54) at or near its resonant frequency to provide a relative oscillatory motion between the probe (20, 54) and surface such that an arrangement of scan lines, whose ~~maximum~~ length is at least one micrometer and directly determined by oscillation amplitude, covers the scan area;
- (c) Measuring a parameter indicative of the interaction strength;
- (d) Monitoring the parameter measured in step (c) or a second parameter which is also indicative of an interaction between probe (20, 54) and sample (12) and, if a value of the monitored parameter falls below or rises above a predetermined set value, adjusting probe (20, 54) - sample (12) separation distance in order to drive the value of the monitored parameter back towards the set value; and
- (e) Processing measurements taken at step (c) in order to extract information relating to the nanometric structure of the sample to form an image corresponding to at least two variations of the measured parameter during each oscillation.

22. (Cancelled)

23. (Currently amended) A scanning probe microscope for scanning or writing to a sample by means of an interaction between the sample and a probe, the microscope comprising:

a first driving means arranged to provide relative motion between the probe and the sample surface and capable of bringing the sample and probe into close proximity;

a second driving means that causes resonant or near resonant lateral oscillation of either the sample or the probe, with an oscillation amplitude of at least one micrometer; and

at least one of a probe detection mechanism arranged to measure at least one parameter indicative of the strength of the interaction between the probe and the sample for imaging the sample, and a probe writing mechanism arranged to generate a periodic interaction force between the probe and the sample to change a property of the sample surface in the locality of the probe for writing information to the sample;

the microscope is arranged, in operation, to carry out a scan of or writing on the sample surface ~~wherein~~ and scan or writing area is covered by an arrangement of scan lines, each scan line being provided by ~~laterally oscillating~~ the lateral oscillation of either the probe or the sample ~~at or near its resonant frequency~~ such that oscillation amplitude directly determines maximum scan line length and the arrangement of scan lines is provided by operation of the first driving means, and ~~wherein the microscope is further arranged~~ readings are continually made by the

probe detection mechanism to form an image corresponding to at least two variations of the measured parameter during each oscillation, or writings are continually made by the probe writing mechanism to form an image corresponding to at least two points during each oscillation.

24. (Currently amended) A scanning probe microscope for imaging a sample in accordance with an interaction between the sample and a probe, the microscope comprising

a first driving means arranged to provide relative motion between the probe and the sample surface and capable of bringing the sample and probe into close proximity, sufficient for a detectable interaction to be established between them;

~~means for oscillating either the probe or the sample in order to provide relative oscillatory motion of the probe across the surface;~~

a probe detection mechanism arranged to measure at least one parameter indicative of the strength of the interaction between the probe and the sample; ~~and~~

a feedback mechanism arranged to provide for adjustment of probe-sample separation via operation of the driving means in response to a variation in an average value of one of the at least one parameters away from a predetermined set value; and

a second driving means that causes resonant or near resonant lateral oscillation of either the sample or the probe, with an oscillation amplitude of at least one micrometer;

the microscope is arranged, in operation, to carry out a scan of the sample surface ~~wherein~~ and a scan area is covered by an arrangement of scan lines, each scan line being provided by ~~laterally oscillating~~ the lateral oscillation of either the probe or the sample ~~at or near its resonant frequency~~ such that oscillation amplitude directly determines maximum scan line length and the arrangement of scan lines is provided by operation of the first driving means, and ~~wherein the microscope is further arranged~~ readings are continually made by the probe detection mechanism to form an image corresponding to at least two variations of the measured parameter during each oscillation.

25. (Currently amended) A scanning probe microscope for imaging a sample in accordance with an interaction between the sample and a probe, the microscope comprising

a first driving means arranged to provide relative motion between the probe and the sample surface and capable of bringing the sample and probe into close proximity, sufficient for a detectable interaction to be established between them;

~~means for oscillating either the probe or the sample in order to provide relative oscillatory motion of the probe across the surface;~~

a probe detection mechanism arranged to measure at least one parameter indicative of the strength of the interaction between the probe and the sample; and

a feedback mechanism arranged to provide for adjustment of probe-sample separation via operation of the driving means in response to a variation in an

average value of one of the at least one parameters away from a predetermined set value; and

a second driving means that causes resonant or near resonant lateral oscillation of either the sample, or the probe, with an oscillation amplitude of at least one micrometer;

the microscope is arranged, in operation, to carry out a raster scan of the sample surface wherein a raster scan area, comprising a length and a width, is covered by an arrangement of scan lines, each scan line being a component of the raster scan and each scan line extending across the width of the raster scan area and being collected by oscillating either the probe (20) or the sample laterally at or near its resonant frequency such that oscillation amplitude determines the raster scan area width.

26. (New) The scanning probe microscope of claim 24 wherein the probe is an AFM cantilever one of the at least one parameter indicative of the strength of the interaction is bending of the cantilever.

27. (New) A scanning probe microscope for AFM, the microscope comprising

a first driving means arranged to provide relative motion between the probe and the sample surface and capable of bringing the sample and probe into close proximity, sufficient for a detectable interaction to be established between them;

a probe detection mechanism arranged to measure at least one parameter indicative of the strength of the interaction between the probe and the sample;

a feedback mechanism arranged to provide for adjustment of probe-sample separation via operation of the driving means in response to a variation in an average value of one of the at least one parameters away from a predetermined set value;

a second driving means that causes resonant or near resonant lateral oscillation of the sample, with a sample oscillation period and a sample oscillation frequency;

an actuator that causes resonant or near resonant vertical oscillation of the probe, whereby intermittent close contact is made between the probe and the sample, and wherein the vertical oscillation has a vertical oscillation frequency greater than the sample oscillation frequency, the vertical oscillation resulting in more than one point of close contact between the probe and the sample during the sample oscillation period; and

the microscope is arranged, in operation, to carry out a scan of the sample surface and a scan area is covered by an arrangement of scan lines, each scan line being provided by the lateral oscillation of the sample such that lateral oscillation amplitude directly determines maximum scan line length and the arrangement of scan lines is provided by operation of the first driving means, and readings of the strength of the interaction between the probe and the sample are made by the probe detection mechanism at each point of close contact during the oscillation period in

order to form an image corresponding to variations of the measured parameter during each sample oscillation.

28. (New) A method of rapidly collecting image data from a scan area of a sample (12) with nanometric features wherein the method comprises the steps of:

- (f) Moving a probe with tip of sub-nanometric dimensions into close proximity with a sample in order to allow an interaction to be established between probe and sample;
- (g) Laterally oscillating either the probe across the surface of the sample at or near its resonant frequency or the sample beneath the probe at or near its resonant frequency to provide a relative oscillatory motion between the probe and surface such that an arrangement of scan lines, whose length is directly determined by oscillation amplitude, covers the scan area;
- (h) Measuring a parameter indicative of the interaction strength;
- (i) Monitoring the parameter measured in step (c) or a second parameter which is also indicative of an interaction between probe and sample and, if a value of the monitored parameter falls below or rises above a predetermined set value, adjusting probe - sample separation distance in order to drive the value of the monitored parameter back towards the set value; and

- (j) Processing measurements taken at step (c) in order to extract information relating to the nanometric structure of the sample to form an image corresponding to at least two variations of the measured parameter during each oscillation.

29. (New) A scanning probe microscope for scanning or writing to a sample by means of an interaction between the sample and a probe, the microscope comprising:

a first driving means arranged to provide relative motion between the probe and the sample surface and capable of bringing the sample and probe into close proximity;

a second driving means that causes resonant or near resonant lateral oscillation of either the sample or the probe; and

at least one of a probe detection mechanism arranged to measure at least one parameter indicative of the strength of the interaction between the probe and the sample for imaging the sample, and a probe writing mechanism arranged to generate a periodic interaction force between the probe and the sample to change a property of the sample surface in the locality of the probe for writing information to the sample;

the microscope is arranged, in operation, to carry out a scan of or writing on the sample surface and scan or writing area is covered by an arrangement of scan lines, each scan line being provided by the lateral oscillation of either the probe or the sample such that oscillation amplitude directly determines maximum scan line

length and the arrangement of scan lines is provided by operation of the first driving means, and readings are continually made by the probe detection mechanism to form an image corresponding to at least two variations of the measured parameter during each oscillation, or writings are continually made by the probe writing mechanism to form an image corresponding to at least two points during each oscillation.

30. (New) A scanning probe microscope for imaging a sample in accordance with an interaction between the sample and a probe, the microscope comprising

a first driving means arranged to provide relative motion between the probe and the sample surface and capable of bringing the sample and probe into close proximity, sufficient for a detectable interaction to be established between them;

a probe detection mechanism arranged to measure at least one parameter indicative of the strength of the interaction between the probe and the sample;

a feedback mechanism arranged to provide for adjustment of probe-sample separation via operation of the driving means in response to a variation in an average value of one of the at least one parameters away from a predetermined set value; and

a second driving means that causes resonant or near resonant lateral oscillation of either the sample or the probe;

the microscope is arranged, in operation, to carry out a scan of the sample

surface and a scan area is covered by an arrangement of scan lines, each scan line being provided by the lateral oscillation of either the probe or the sample such that oscillation amplitude directly determines maximum scan line length and the arrangement of scan lines is provided by operation of the first driving means, and readings are continually made by the probe detection mechanism to form an image corresponding to at least two variations of the measured parameter during each oscillation.